

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1 (previously presented): A method of production of a steel product with a nanocrystallized surface layer,

said method of production of a steel product with a nanocrystallized surface layer characterized by comprising:

(1) subjecting a surface layer of a steel product to ultrasonic impact treatment by impacting it at a plurality of different directions using ~~by~~ one or more ultrasonic indenters ~~vibrating in a plurality of directions~~, with said ultrasonic impact treatment of said surface layer providing equiaxial grains in said surface layer, then

(2) subjecting the surface layer subjected to the ultrasonic impact treatment to heat treatment at 100 to 500°C for 15 minutes or more to cause precipitation of nanocrystals.

2 (Currently Amended): A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, characterized in that ~~the surface layer of the steel product subjected to said ultrasonic impact treatment is in~~ produces an amorphous state in said surface layer.

3 (Previously Presented): A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, characterized in that said ultrasonic impact treatment is accompanied with mechanical alloying.

4 (Previously Presented): A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, characterized by making an amorphous phase and a nanocrystal phase copresent in precipitation of said nanocrystals.

5 (Previously Presented): A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, characterized by shielding the surroundings at the time of said ultrasonic impact treatment from the air.

6 (Canceled).

7. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein each of said one or more indenters vibrates in one or more of said plurality of different directions.

8. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein said one or more indenters comprise three ultrasonic indenters, and wherein at least one of the indenters is arranged to provide an incident angle with respect to the surface layer of the steel product of 30 degrees or more.

9. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein said one or more indenters comprise three indenters, and wherein the three indenters are arranged at 120 degrees from each other.

10. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 8, wherein vibration waveforms of the indenters are offset by 1/3 period from each other.

11. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 9, wherein vibration waveforms of the indenters are offset by 1/3 period from each other.

12. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein the one or more indenters are made to vibrate simultaneously in the vertical and the horizontal direction.

13. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein said ultrasonic impact treatment is by impacting said surface at a plurality of different directions using one indenter made to turn or rock.

14. (New) A method of production of a steel product with a nanocrystallized surface layer as set forth in claim 1, wherein a temperature of the ultrasonic impact treatment is made to be a temperature sufficiently lower than the recrystallization temperature of the steel.